

the Red Crag of Woodbridge (Brit. Mus. nos. 43328, P. 5582). These are more laterally compressed than the vertebrae of *Thynnus scaldisiensis*, and differ remarkably in the stouter and broader proportions of the ridge between the lateral fossae. Discoveries in the Eocene render it probable that these fossils represent some early Tertiary genus at present undetermined.

XLII.—*Notes from the St. Andrews Marine Laboratory (under the Fishery Board for Scotland).*—No. XI. By Prof. M<sup>c</sup>INTOSH, M.D., LL.D., F.R.S., &c.

1. On the Occurrence of the Hydromedusæ and Scyphomedusæ throughout the Year.
2. On *Arachnuctis*.

1. *On the Occurrence of the Hydromedusæ and Scyphomedusæ throughout the Year.*

In examining the Medusæ three nets were often used simultaneously, viz. surface, midwater, and bottom, and no special apparatus was at any time employed for the closure of the two latter during descent and ascent. Fairly reliable observations, however, were made with regard to the bathymetrical distribution of these pelagic organisms without the latter arrangement, as proved by the fact that each net occasionally had a fauna of its own, and that, as the season advanced, certain forms which at first were near the bottom appeared by-and-by in the midwater- and finally in the surface-net. In August 1888, for instance, the surface-net was less rich in species of Hydromedusæ than either of the others, though certain forms occurred in great abundance, a transference of the latter from the lower regions of the water having taken place.

It is possible that some of the forms subsequently mentioned may pertain to the same Hydroid stock, representing perhaps younger and older stages or mere variations; but as our knowledge of the group, though largely added to by the labours of Allman, Agassiz, Hæckel, Hincks, and others, is still in need of improvement, it has been considered advisable to follow to a certain extent the descriptions of Forbes. No gonozooid of *Corymorpha*, which occurs in considerable numbers on smooth ground off the Buddha Rock, has yet been obtained.

In contrasting in August the fauna of the bay with the offshore in the neighbourhood of the Bell Rock, the greater

abundance of *Lizzia octopunctata* and *Lizzia blondina* in the latter area is noteworthy. Moreover, small specimens of *Bougainvillia britannica* were abundant in the open water. Minute Medusa-buds were common to both areas, as also were *Thaumantias inconspicua*, *T. hemisphærica*, and *T. melanops*.

The importance of the Medusæ in regard to the fisheries rests mainly on the vast number of ova and the resulting free planulæ which they produce, for both largely increase the food-materials for larval and early post-larval fishes, as well as for the Invertebrates on which they and the somewhat older stages feed.

In the laborious work of examining the various nets throughout the year I have to acknowledge the skill and steady perseverance with which Mr. Pentland Smith, M.A. (now of the Horticultural College, Swanley), aided me.

*Oceania (Tiara) octona*, Fleming, first appeared in the bottom-net in March. In August it was often procured in the midwater-net and in a ripe condition, while in September both large and small specimens were common; some were ripe. Since Dr. Fleming found the species in this neighbourhood in 1821 it has occurred all along the eastern coast. *Oceania conica* is ripe at Naples in March, while *O. pileata* is mature in January.

#### *Oceania episcopalis*, Forbes.

An example about  $\frac{1}{4}$  inch in diameter occurred in the midwater-net in the middle of June. It seems to be much less common than the preceding species. It was found by Forbes on the western fishing-banks of Shetland in 1845, the largest reaching  $1\frac{1}{2}$  inch in diameter.

#### *Oceania globulosa*, Forbes.

In the midwater-net in August and once in September. Forbes procured his examples in Bressay Sound, Shetland, in 1835.

Besides the foregoing an *Oceania* was captured in August with only one yellow tubercle (instead of three) between the tentacles, with pinkish ocelli and ovaries, and quite mature. In other respects it resembled *O. octona*. Another had no tubercles between the tentacles, which were in four groups, five in each, and with two additional. The ocelli and ovaries resembled those of *O. octona*.

*Bougainvillia britannica*, Forbes (*Margelis ramosa*, Agassiz).

A single example appeared in the midwater-net in March; in May only once, in small numbers. It occurred almost daily in June in the midwater-net, and of variable size. None were quite ripe. A single large immature specimen was captured in July; and it was comparatively scarce in August, though towards the end of the month it was ripe. Many small examples frequented the open water beyond the bay. Throughout September it occurred in small numbers, and many were ripe.

It is common round the British shores. Prof. Allman\* observes that the gonosome is developed in autumn. Lo Bianco† states, on the authority of Du Plessis, that this Hydromedusa appears in winter and spring in the Bay of Naples.

The polyparies are found off St. Andrews Bay and the neighbourhood of the Forth.

*Bougainvillia nigritella*, Forbes.

Small specimens were captured in the bottom-net in April and comparatively large examples in the midwater-net in August. Ripe forms occurred once or twice in September. Forbes found it in Bressay Sound, Shetland, in the autumn of 1845.

*Lizzia octopunctata*, Sars, was first captured in the bottom-net in March, in the midwater-net in April, when the specimens also had buds, and only once in May. One or two examples were obtained during the first half of June. In August again it appeared in the surface-net.

It seems to be most frequently procured in early spring, and is generally distributed along the eastern coast. Forbes found it on both sides of Shetland. It is not an abundant form in the bay, and it ranges from  $\frac{1}{15}$  to  $\frac{1}{10}$  inch in diameter.

*L. octopunctata* is an active and voracious form, engulfing the bodies of Appendiculariæ, while the tails project as singular appendages to the Medusa, and the same happens to small Sagittæ, the end being fixed in the manubrium, and sometimes the umbrella is everted.

At Naples *L. Köllikeri*, Gegenb., is ripe in March.

*Lizzia blondina*, Forbes.

Procured on the ground near the Bell Rock in August. It was formerly obtained by Forbes in the Zetlandic seas.

\* 'Gymnoblastic or Tubul. Hydroids,' p. 312.

† Mitth. Z. Stat. Neapel, 8 Bd. p. 385 (1888).

*Sarsia tubulosa* (Sars), Lesson.

This species made its appearance towards the end of April, and a few attained half an inch in diameter. Throughout May and June it occurred in the midwater-net almost daily and of variable size, though many were small. All were immature. At the commencement of July all were in the latter condition, and small, but they became larger as the month advanced, comparatively few, however, being obtained at any given time.

In the Ann. & Mag. Nat. Hist. for August 1887 the Hydroids which were reared from plannæ of *Sarsia* are mentioned, the species being *Syncoryne decipiens*, Dujardin. As this Hydroid is not common in the Bay of St. Andrews, these Medusoids probably were carried by currents from the estuary of the Forth and the neighbourhood; yet they were in great numbers, penetrating all the nooks of the bay, and passing far up the estuary of the Eden.

Forbes chiefly found this form in June and July off the coasts of Ireland and Shetland. It is very generally distributed, however, along the eastern shores and probably also on the western.

*Sarsia (Codonium) pulchella*, Forbes,

Obtained in May. It has a greenish tinge at the oral extremity. The relations of this form require elucidation.

*Syncoryne eximia*, Allman.

The gonozooid of this form was captured in May.

*Stauridium productum*, S. Wright.

Gonozooids procured in June and July. Lo Bianco gives October as the month for them at Naples.

Besides the foregoing, a gonozooid of *Podocoryne carnea*, Sars, occurred in July. Lo Bianco thinks this species at Naples sends off buds throughout the year.

*Thaumantias pilosella*, Forbes (*Laodice cruciata*, Agassiz), was captured sparingly in April and May, increasing in size as the latter month advanced, small specimens being most common in the former and the beginning of the latter month. In June swarms occurred in the midwater-net almost every day, and the individuals as a rule were somewhat larger than in the previous month, though not quite mature. They were

nearly ripe in August. At the beginning of September many had attained  $1\frac{1}{8}$  inch in diameter and were mature.

Forbes described *T. pilosella* only from Shetland and the south of England; but it is abundant all along the eastern shores.

In this species, as in allied forms, it is probable that after discharge of the reproductive elements the Hydromedusæ perish; they certainly disappear from the areas they previously frequented in myriads.

An undetermined form\* was met with at the beginning and end of June, and often in great numbers in July, many having the male elements fully developed, but none had ripe ovaries. They were notable for their size ( $1\frac{3}{8}$  inch in diameter). This species likewise occurred in the midwater-net in August and once in September. It differs from *Thaumantias pilosella* in the arrangement of the tentacles and the great length of the manubrium, which is proportionally almost as large as in *Tima*.

*Thaumantias quadrata*, Forbes.

An immature example occurred in the midwater-net in August. Forbes found it abundantly in the harbour of TARBET, Loch Fyne, in the autumn of 1845. It would appear to be a late Medusoid.

*Thaumantias octona*, Forbes.

Numerous examples of this small form were captured in the middle of June. It also occurred in the surface-net in August. All were immature. Forbes procured it both at Oban and at TARBET, Loch Fyne.

*Thaumantias melanops*, Forbes, came somewhat sparingly under notice in May, and, as in the former case, increased in size as the month advanced. It occurred in multitudes in the midwater-net in June, and on an average larger than during the previous month. One,  $\frac{5}{16}$  inch in diameter, had fully-developed ova on the 13th of June. It was one of the most conspicuous Hydromedusæ in July, when it was fully mature. Some reached  $\frac{3}{4}$  inch in diameter. While appearing almost daily in the midwater-net, it also towards the end of the month was found in the bottom-nets, though the specimens in these were small and immature. It occurred both in the midwater- and bottom-nets in August.

It is generally distributed along the eastern coast. Forbes procured it in Shetland.

\* *Vide* Report of the Fishery Board for Scotland, ix. pl. v. figs. 6-9.

*Thaumantias maculata*, Forbes.

In June this form well illustrated the variability of a species in regard to maturity. Specimens were very numerous and very ripe on the 23rd, while those obtained on the 25th were immature. At the beginning of July they were almost ripe and fully half an inch in diameter, and a week or two afterwards others of the same size were mature. This variability in regard to maturity probably depended on the stage of growth of a particular series, which it may be was swept by currents into the bay.

Forbes found this Hydromedusa several times in Bressay Sound, Shetland. It was never plentiful.

*Thaumantias gibbosa*, Forbes.

Many examples apparently of this form were procured in the midwater-net on the 13th and 18th June.

Forbes captured it in the Hebrides.

*Thaumantias pileata*, Forbes.

A few specimens referable to this species were procured at the beginning of June.

It was discovered by Forbes at Portrush, on the north coast of Ireland, in June 1839.

*Thaumantias hemisphærica* (Gronovius), O. F. Müller.

This, perhaps, is the most conspicuous of the group both in regard to size and numbers in June, and it is often stranded on the West Sands in great profusion, and nearly 1 inch in diameter. Moreover it has an additional interest, since it is frequently selected by the larval *Peachia* for attachment by the widely open mouth and tentacles. The young anemones are thus carried about without effort on their part, and obtain some of the advantages of the *Arachnactis*-stage of *Edwardsia*. *T. hemisphærica* reached full maturity this month. During July it was in great profusion in the midwater-net and occasionally appeared in the bottom-net; and since the latter feature did not occur previously, it may be presumed that it was not entirely due to the capture of the Medusoids on the way up. Larval anemones (*Peachia*) now considerably larger still adhered to this species and to *T. melanops*, occupying diverse positions, as on the outer surface at the margin of the base or on the manubrium. The Hydromedusæ were also often fully ripe. Some of the larger exceeded  $\frac{3}{4}$  inch.

Small examples were common in the bottom-net in August,

both inshore and offshore, as in the neighbourhood of the Bell Rock. Mature specimens again were numerous in the midwater-net, many having larval *Peachie* attached to them both in and beyond the bay, though perhaps they were most numerous within the limits. In the surface-net it occurred in limited numbers and in full maturity with many free ova.

The numbers were not much diminished throughout September and the majority were ripe. In the earlier part of October many were mature, others nearly so. Many occurred in the midwater-net during the first half of the month, and they ranged on each side of  $\frac{5}{8}$  inch. Even in December a few examples were captured in the midwater-net.

The species appears to be common all round the shores of Britain, as well as in the North Sea generally.

*Thaumantias lucifera*, Forbes.

Minute specimens were found in the bottom-net in March. It also occurred sparingly in May, while in June great numbers were met with at the beginning and end of the month. It was generally under  $\frac{1}{4}$  of an inch. It appears to be generally distributed round the British shores.

*Phialidium variabile* (= *Thaumantias globosa* &c., Forbes) was captured sparingly in May and June in the midwater-net. Its size ranged from  $\frac{1}{4}$  inch in diameter downwards. None were quite mature.

The same species in the varieties *globosa*, *convexa*, and *sarnica* appeared in the midwater-net in August, as well as in the bottom-net—chiefly at the beginning of the month.

Forbes limits its occurrence to Shetland, on both sides of which it was found plentifully in the harbours. It seems to have a wide range on both eastern and western shores of Scotland.

*Phialidium variabile*, var. *inconspicua*, Forbes, occurred in considerable numbers several times about the middle of June. All examined were immature, and none exceeded  $\frac{1}{4}$  inch in diameter. It was in full maturity in August, abounding in the bottom-net at the beginning of the month, while comparatively few were got in this net towards the end. It also appeared in the midwater- and surface-nets.

Forbes procured this form in the Hebrides.

Besides the foregoing a few examples of a *Thaumantias* appeared in the midwater-net in February and April. In the same net a small form was procured on the 24th May

which does not seem to correspond with anything named. It had numerous brick-red and comparatively large ocelli.

It is no wonder that the Medusoids of this type are so abundant in St. Andrews Bay, since *Obelia*, *Clytia*, and the Campanularians are so common.

*Clytia Johnstoni.*

The gonozooids are characteristically plentiful in April, issuing from the stock in swarms. Moreover the old polypites and thecae were thrown off and new ones reproduced. Lo Bianco observes that at Naples the formation of the Medusoids occurs in the gonophores from October till March, while the free Medusoids are procured in January.

In July numerous minute Medusoids, some probably pertaining to *Obelia*, were captured in the bottom-nets. They had perhaps only recently gained freedom, and, along with the various planulae, frequented the lower regions of the water. Medusoids are very common all round the British shores during this month, and the water is sometimes rendered phosphorescent by the swarms from *Obelia* alone. These frequently occur at the surface as well as throughout the water.

*Tima Bairdii*, Johnst.

In January specimens were captured fully 2 inches across and almost colourless, the peduncle alone showing a whitish tip, with a faint brownish hue at the base of the tentacles. The reproductive elements were well advanced, so that the spawning-period could not be far distant. Only a single small example was procured in February in the midwater-net. In May a few comparatively young specimens also were obtained. It is noteworthy, however, that no very small examples have been seen, though occasionally in its earliest phases it may have escaped observation or have been confounded with other forms, especially as the young is unlike the mature form. Only two small examples, one within and one without the bay, were got in August. Both small ( $\frac{3}{4}$  inch) and fairly grown forms (about  $1\frac{1}{2}$  inch) appeared in the midwater-net in September, as also the small abnormal one formerly described\*. All were immature. The same remarks apply to October, the largest, however, being only  $1\frac{1}{4}$  inch in diameter. In December *Tima* reached its maximum size, a specimen fully 3 inches across being captured in the midwater-net. A few of medium

\* *Vide* Ann. & Mag. Nat. Hist. January 1890, p. 41.



size were also procured in the surface-net. The reproductive organs were well developed, but not quite ripe. This month and January would appear to be the period during which these Hydromedusæ as a rule reach full maturity. Lo Bianco states (*vide* Chun) that the ova of *Tima flabellaris* are ripe in October.

This form was first observed by Dr. Johnston, of Berwick, in 1833, and shortly after by Edward Forbes on the West Sands at St. Andrews. It abounds all along the eastern shores of Britain to the estuary of the Thames.

The Hydroid stock from which *Tima* springs is not well known, though Hæckel gives *Laföä* and *Campanularia* for the group. Louis Agassiz had formerly raised the Campanularian zoophyte from an American *Tima*.

#### *Willia stellata*, Forbes?

Another gonozooid 2.5 millim. in diameter presented a somewhat globular umbrella with twenty-four large purplish tentacular bulbs, from which proceeded as many slightly pinkish tentacles. The subumbrella reached nearly to the tip of the umbrella. The lips of the peduncle were produced into four branched filiform processes. The four double ovaries were filled with large orange-red ova, apparently ripe.

*Melicertum (Stomobrachium) octocostatum*, Sars, appeared in the midwater-net in January, and thereafter disappeared till August, when small numbers were captured once in the same net. It occurred sparingly once or twice in September and of good size. Throughout October similar specimens were occasionally met with in considerable numbers. None were mature. It was somewhat plentiful in the surface-net at the commencement of December, and a few,  $\frac{1}{2}$  inch in vertical diameter, likewise were got in the midwater-net. This form appears to attain full size at St. Andrews. Forbes did not frequently meet with this common species.

*Circe rosea*, Forbes, was present in great numbers in January, not only in the bay but far out at sea, and at surface, midwater, and bottom. Vast numbers continued throughout February in the midwater-net and smaller numbers in the surface- and bottom-nets. Many young specimens were present. In the large forms the reproductive organs showed numerous clear cells. In March they were still very abundant in the midwater- and bottom-nets, and the majority were full-grown, though small forms were also mingled with them. *Circe* attained full growth in April; indeed no larger forms

were seen, and the reproductive organs were well developed. The species then disappeared till November, when it occurred in considerable numbers, though none were large. Throughout December it appeared sparingly in the surface-net, but of somewhat larger size than in the previous month; while in the midwater-net it was in profusion, the larger forms being about  $\frac{5}{8}$  inch, the smaller less than  $\frac{1}{4}$  inch. The reproductive organs were fairly developed. This species and *Pleurobrachia* occurred in three out of four hauls in the bottom-net. *Circe* thus forms one of the features of the pelagic fauna during the winter months.

Forbes found the species only in the Zetlandic seas in 1845. It is, however, abundant off the east coast of Scotland. L. Agassiz, again, mentions that he procured the American form only in July. Forbes points out the difference of his species from Brandt's in regard to the eyes, which are absent; but A. Agassiz observes that what Forbes took for ocelli in Brandt's figure are only sections of the chymiferous tubes.

#### *Scyphomedusa.*

Minute ephyrae about  $\frac{1}{30}$  inch in diameter appeared in the bottom-nets towards the latter third of February. Swarms again occurred in March in the same region. A wealth of Medusoid life is found close to the bottom at this season. In May considerable numbers of young *Aurelie*, ranging from  $\frac{1}{8}$  to  $\frac{1}{2}$  inch in diameter, were captured. As the month advanced they increased in size, and the contrast was still greater when placed side by side with the minute forms procured in March. Young *Aurelie* and *Cyanea* are often beached on the sands in May. In July (1888) the adults were comparatively rare, a condition unusual in ordinary seasons. Thus only a young example  $\frac{1}{2}$  an inch across was found in the midwater-net at the beginning of the month and a few larger in the same net on the 19th. As a rule the immense numbers of these forms prove troublesome in the trawl- and other nets both from their stinging-powers (*Cyanea*) and their weight.

In regard to *Cyanea* a single example  $\frac{3}{8}$  inch across the disk was procured in June, and only once were a few specimens 7 or 8 inches in diameter stranded on the sands (June). In former years not only did this form and *Aurelia* abound at the surface of the bay in July, but far out at sea. It would seem that warm sunny weather is connected with the presence of these and other marine forms at the surface. It

is worthy of note that once in January a large example was procured by the trawl in deep water and at a considerable distance from the shore—a solitary survivor of the hosts of autumn.

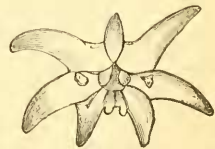
## 2. On *Arachnactis*.

In the Zetlandic seas no more conspicuous form than *Arachnactis* occurs amongst the pelagic animals in July. It is, however, by no means common along the eastern shores of Scotland, so far as present experience goes. At Plymouth, again, Mr. Harmer stated at the meeting of the British Association at Newcastle that it was abundant. Its comparative rarity in the Bay of St. Andrews is peculiar, since *Edwardisia* are by no means unfrequent; indeed, the stomachs of some Pleuronectids are filled with them. The only example yet observed at St. Andrews is a minute form about  $\frac{1}{8}$  inch in diameter which was captured in the midwater-net on the 11th June amongst Hydromedusæ and other Coelenterates. In lateral view (fig. 1) it somewhat resembles a cushion-star, and is more or less translucent, a faint tinge of yellowish existing only at the tips of the tentacles. Of the latter, four are conspicuously larger than the rest, three a little shorter, while two tentacle-buds occur opposite the median one (fig. 2). The oral region shows two prominent papillæ, and the mesenteries, though apparently not quite complete, are well marked.

Fig. 1.



Fig. 2.




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XLIII.—*British Fossil Crinoids*. By F. A. BATHER, B.A., F.G.S., Assistant in the British Museum (Natural History).

[Plate XIV.]

### I. *Historical Introduction*.

THE fossil Crinoidea of the British Isles are of great interest to the zoologist, for in the early days of geology they attracted the attention of many enthusiastic workers and most of the common genera were established on the evidence of British specimens. The first work of any importance is James